

Sustainability of Cardboard Packages

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Abstract

*Sustainability is an essential part of production and business strategies in the pulp and paper industry, which is active in the three interdependent pillars of sustainability: environmental, economic and social. The combination of environmental, economic and social aspects of activities in the packaging sub-sector of the industry is an example of sustainability guaranteed within the framework of the circular and bio economy. Cardboard packages are one of the most produced assortments in the paper industry. They are an excellent example of production that meets the requirements of the circular economy, based on the principles of sustainable consumption of resources, sustainable production and sustainable development. **The aim** of this research is to present the characteristic and role of cardboard packages as an example of sustainable production and consumption. In the study have been used the **descriptive - analytical approach, the methods of comparison, analysis and synthesis.***

Keywords: sustainability, packaging, cardboard packages, circularity, environmental

JEL Code: Q01, Q23, L73

Introduction

Over the last two decades, there has been growing interest from all stakeholders (government, manufacturers, and consumers) to make packaging more sustainable. Paper is considered one of the most environmentally friendly materials available. A qualitative study of authors (Oloyede & Lignou, 2021) concluded that the key message that emerged from the discussions was the “**3Rs**”—**Reduce, Reuse, and Recycle**”—which should be the main points to consider when designing a sustainable packaging. The key characteristics outlined for a sustainable package were functionality, clear information, aesthetic value, and product shelf life. In summary, consumers expect a sustainable package to do everything a standard package would do and not be harmful to the environment (environmentally friendly) at the same time.

Stars and Matuana summarized that consumer demand and emerging regulations will continue to drive the movement toward sustainable packaging. Biobased materials such as wood-based paper and paperboard are ideally positioned to capture some of this market growth (Stark & Matuana, 2021). Other authors (Krah, Todorovic & Magnier, 2019) mentioned that companies and manufacturers need to innovate in this domain in order to fulfil the sustainability and circularity requirements that many governments have established. Therefore, designers need to address the functional aspects of packaging and importantly they need to make it less detrimental for the environment. To truly have a positive impact, consumers need to choose for these sustainable packages, and it is therefore important to understand packaging sustainability from a consumer point of view.

A review of Escursell and others (Escursell et al, 2021) shows that the current trend is to recycle and to search for **biodegradable, compostable or renewable packaging materials** that can be easily disposed of with no waste. Rethinking packaging design is being considered to depart from conventional uses. Higher customer satisfaction could be achieved, if there is less variation with respect to the service wanted by the customer and delivered on time (Stefanova, 2022). Moreover, according to researchers (García-Arca et al, 2020), **packaging design** is one of the potential strategies for increasing logistics performance, not only from a cost reduction perspective, but also from a sustainable point of view. The deployment of a sustainable vision in packaging design should demand a holistic view of packaging, supply chain and product; this integrated vision is the main point of the “**Sustainable Packaging Logistics**” (**SPL**) approach. At a logistics level, a key link with the different stages of the supply chain is the secondary packaging, which most

commonly takes the form of a **corrugated cardboard box**. Corrugated packaging is one of the most recycled paper products in practice today, with a well-established market for secondary raw materials. Efficient recycling processes allow fibres to be reused for new packaging. (FEFCO, 2022).

The aim of this research is to present the characteristic and role of cardboard packages as an example of sustainable production and consumption. In the study have been used the *descriptive - analytical approach, the methods of comparison, analysis and synthesis*.

1. Sustainability and packaging

According to the U.S. Environmental Protection Agency (EPA), “Sustainability is based on a simple principle. Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations.” (Focus on Sustainability, 2022)

Sustainability is the basis of today's leading global framework for international cooperation - the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs) (Sustainable Development, 2022). It is a European brand. The European Union (EU) has taken a strong starting position and has shown significant results with a high level of economic development, social cohesion, development of democratic societies and a commitment to achieving sustainable development firmly rooted in the European Treaties (Ustoychivo razvitie, 2016). Environmental sustainability is an important driver of change for industry today, driven by growing social awareness and pressure, economic implications and tighter regulations (Thiede, 2021).

Authors (Nayyar et al, 2014) emphasize that numerous organizations have been synergizing efforts related to eco-friendly packaging such as (SPC) of United states of America i.e Sustainable Packaging Coalition and (SPA) of Australia i.e Sustainable Packaging Alliance has defined that sustainable packaging main area of concern is to give candid and common industry sharing norms, which result in offering guidance for good decision making with much more clarity in modelling vision for more eco-friendly packaging system. Major highlighting principles of SPA define eco-friendly packaging in four terms: *effective, efficient, cyclic and safe*. Here effective signifies, innovation in packaging should emphasis on improving it functionality. The overall system should focus efficiently, in fading the use of water, energy and materials named as natural resources whereas wastes and emissions of toxic gases should be limited throughout its life cycle. Even consideration is on maximizing the retrieval of raw products and reducing degradation of them throughout their life cycle. Health issues and more safety standards are to be designed to improve our ecosystem whereas SPC has highlighted criteria that portray vision for eco-friendly and its overall impact on sustainable development:

- Safety and health of individuals and communities throughout their time span.
- Match criteria of market with reference to cost and performance.
- Renewable sources of energy must play significant role.
- Use of clean and best practices of production.
- Healthy material must be used as the raw material.

Packaging is an important element to consider in order to decrease the ecological footprint of a product. Authors (Krah et al, 2019) define packaging sustainability as the attempt to *reduce the environmental footprint of a package*. Companies, who do research in sustainable packaging solutions, have several possibilities. New approaches are focused on *reusable returnable packaging* possibilities (after use of the product, it is returned to the shop, from where it is returned to the manufacturer and re-used) or *new materials for packaging* (f.e. biodegradable or recycled). All approaches towards sustainable packaging are intended to benefit the environment, minimise the carbon footprint of man-made packaging waste and also to cut down costs (Zavodna &

Trejtnarova, 2021).

Globally, paper-based packaging has the potential to tackle marine debris and lead to a lower impact of packaging in the environment. This is especially necessary as the amount of packaging used is steadily increasing due to small portion packaging, urbanization, and a growing worldwide population (Oloyede & Lignou, 2021).

The global green packaging market size was valued at USD 274.15 billion in 2020 and is expected to grow at a compound annual growth rate (CAGR) of 6.1% from 2020 to 2028. Growing consumer awareness regarding sustainable packaging, together with the strict bans regarding the usage of single-use plastics, are expected to fuel the industry growth. Based on type, the market is categorized into recycled content, reusable, and degradable packaging. The recycled content segment held the largest share of 61.2% in 2020 (fig. 1) (Green Packaging Market, 2020).

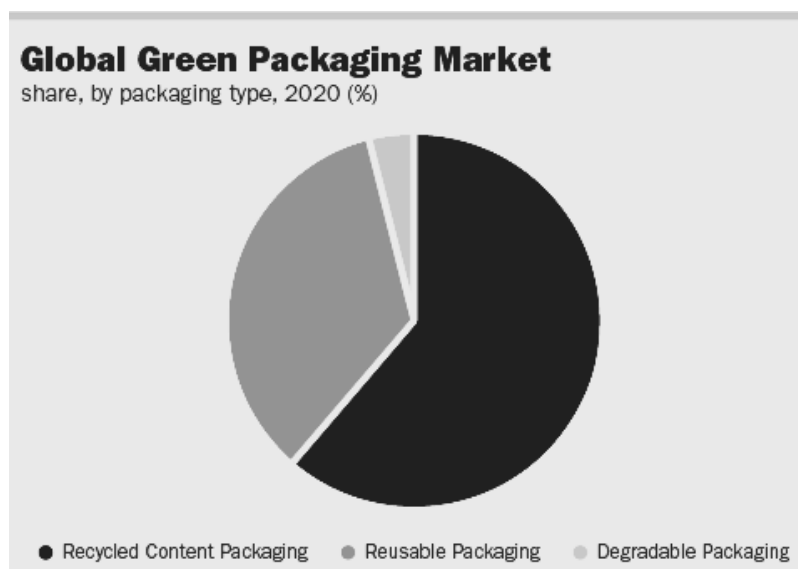


Figure 1. Sustainable packaging market by type

Source: Grand View Research, 2022

According to survey of McKinsey&Company (Feber et al, 2022), sustainability remains the number-one topic across the packaging value chain, with corporations setting ambitious targets to improve their performance. Sustainability is the key driver for packaging design across all industries and regions (fig. 2).

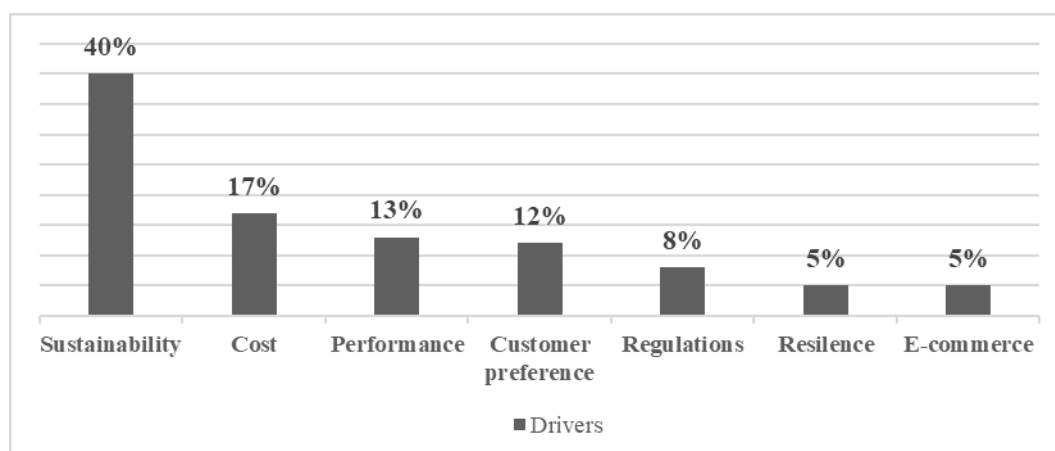


Figure 2. Drivers for packaging design

Source: McKinsey&Company, 2022

Packaging, especially the box, plays an overarching and facilitating role to actively contribute to sustainable improvement of supply chains within a conceptual framework called “Sustainable Packaging Logistics” (García-Arca et al, 2020)

Logistics defines a techno-economic function which balances the need for product safety, material use competence and the packaging material impact in the supply chain. The efficiency of packaging in logistics is considered together with environmental conditions in the processes of supplying, packing, handling, storing, and transport. The study of market trends has been a major parameter while using any product in any organization. Logistics needs a reliable outer protection for its goods in transit. Corrugated Cardboard provides a cost-effective and a sustainable covering making it an irreplaceable option under economic and technological aspects (Sharma et al. 2020).

2. Characteristics of cardboard packages

Paperboard is the most used packaging material worldwide, accounting for approximately 33 percent of packaging material consumption. Types of paperboard packaging include cardboard and folding boxboard (Fernández, 2022) (fig. 3).

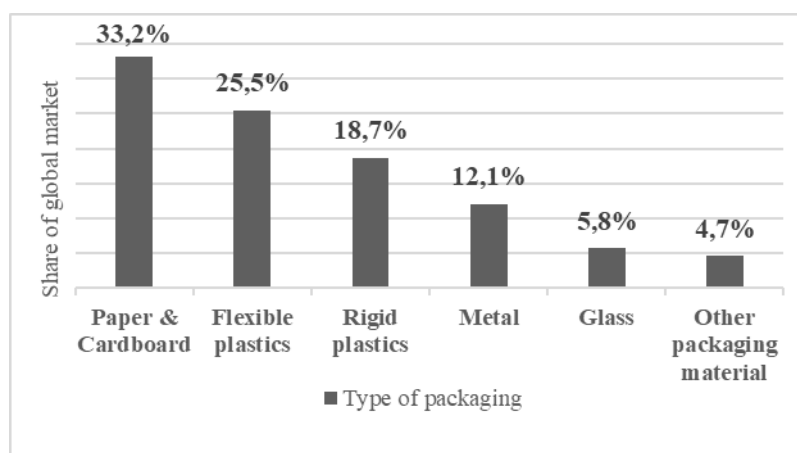


Figure 3. Distribution of packaging demand worldwide in 2019, by material type

Source: Statista, 2022

In the packaging market, cardboard boxes are the type of the **most popular boxes** which are used for most goods to limit the damage of the inside products during the transport process. More and more enterprises choose and utilize the cardboard box for their products all over the world. It helps create a perfect appearance for products in order to garner the attention of customers. Besides, the prominent characteristics of cardboard boxes are to make buyers have a good appreciation for the product quality that is packed inside. When packaging is attractive and beautiful, users will have more trust in a product purchased being actually the top-notch one. This is the method of improving the brand’s reputation that always brings a great result for businesses.

The cardboard box is thought of as the type of cutting-edge packaging that reaches the significant innovation in design and takes advantage of the packaging aspect in the world. It meets the complete requirements of businesses, including the preservation and storage of goods. Moreover, cardboard boxes are a great choice with the aim of shipment. **Corrugated boxes, folding boxes, and rigid boxes** are the main types of a cardboard box which is employed by lots of customers. The feature of the rigid box is firm and unfold, so it is able to prevent products from the damage of impact. That is the reason why it is usually used for top-notch goods like electronic devices. The second type is folding boxes which have a flexible ability in an easy way. therefore, this packaging will be a pack for foods, medicines, and perfumes. Cardboard boxes which are designed in various sizes to meet various aims for many fields such as clothing stores, shopping center, grocery stores, and designer companies.

The **advantages** of cardboard boxes include:

- highly flexibility;
- diversity;
- carton paper is easily used to print messages, information, logos, and images with perfect quality: manufacturers apply modern printing techniques with various colors and patterns;
- no difficulty for manufacturers to alter the dimension of boxes under users' requirements;
- solve many environmental issues because cardboard is reused, recycled, and disposable material;
- the production cost of this type of box is inexpensive, so businesses do not spend too much expense on the packaging;
- able to be made an aesthetic design in many different methods;
- light weight;
- ensure the maximum security of the products;
- easy to load into vehicles. (The characteristics of cardboard boxes in the packaging industry, 2020).

Cardboard, also known as corrugated cardboard, is a specially engineered material made from paper pulp. It's made up of different components that work together to make it strong, lightweight and versatile. As a most sustainable packaging choice, cardboard is: **recyclable, reusable, renewable, biodegradable**. Cardboard is typically created using three carefully assembled layers of paper. These layers include an inside and outside liner with a corrugated layer – or fluting – in the middle. It's this simple but innovative design that makes cardboard packaging so robust. The flutes prove effective insulation from outside temperatures, whilst also keeping the structure nice and sturdy. The most common types of cardboard package include:

- **Single-Faced Corrugated Board**: consists of liner paper and fluting for wrapping around items to prevent them from being damaged;
- **Single-wall corrugated board**: made from an outer liner, the fluting and an inner liner for lighter items;
- **Double wall corrugated board**: made to be strong and durable, this type of cardboard is created by gluing two single-faced corrugated webs together and laminating them to a liner web;
- **Triple wall corrugated board**: heavy duty cardboard that's great for protecting valuable items. It consists of three single-faced corrugated boards with different types of fluting and an outer liner. Increasing need for manufacturing and sourcing processes for sustainable packaging products (What is Cardboard, 2022).

Corrugated cardboard is incredibly versatile and customizable, and provides a high level of protection at low cost that just cannot be beaten by most alternatives. Corrugated board is an eco-friendly packaging material, comprised of recyclable materials like used cardboard carton and old newspapers. Among the most widely recycled material globally, some corrugated board is even made from **100% recycled materials**. The average composition is from 70 to 90% recycled materials, which still beats plastic and wood packaging by a long shot. corrugated cardboard is often produced without the use of dyes or bleaches, further reducing its footprint and level of recyclability. Corrugated packaging is also reusable - many times cartons are folded up and stored for use again in offices, at home and in some stores. Since it is sustainably created using a high percentage of recycled materials, the energy required to produce corrugated packaging is greatly reduced - one of the "greenest" logistics packaging solutions available globally. (Sustainability, 2021).

Authors summarized the various substantial competitive advantages of corrugated cardboard or fiberboard used worldwide as packaging including the context of green logistic:

- **High mechanical resistivity**: the products developed and transported are protected due to the mechanical actions by the structure of the container;

- *Lightweight material*: the thickness of the material does not compromise on its weight, the reason being the gaps of air within the ridges;
- *Reduced production cost*: the production costs are specifically lowered due to the material used in various segments of the packing sector;
- *Circular by nature (Recyclable)*: the packages made from the corrugated cardboard can be recycled into new packaging after they are used once and disposed of result the least impact on the environment;
- *Optimization*: packaging fits mostly to any business and product by creating their own customizations and specifications;
- *Traceability*: the recent innovations in logistics have included Radio Frequency Identification-Enabled Packaging which can easily trace the parcel's location in its transit. This makes it easy for the identification of the procedure at any given time in the logistics process;
- *Informative*: the visibility of a packaging makes it a clear and an authentic parcel in its transit;
- *Cost analysis procedures*: proper stance on how packaging cost is affected, we should be examined as an integrated part of the logistics (Sharma et al, 2020).

The advantages of cardboard packaging and their versatile application cover the features and criteria for defining them as **sustainable packaging**.

3. Sustainability of cardboard packages

Sustainable development is a global objective that aims to address the societal challenge of climate action, the environment, resource efficiency, and raw materials. In this sense, an important strategy is the promotion of green packaging, that is, the use of sustainable materials and designs for the packaging of goods. In recent years, many research works have been published in the specialized area covering the different perspectives and dimensions of green packaging. The results obtained from authors (Wandosell et al, 2021) allow them to respond to the question about green packaging from consumer and business perspectives. From a business perspective, it was observed that companies are being forced to adapt green packaging initiatives due to the societal pressure derived from environmental concern, and customers' attitudes and willingness to pay, in addition to other factors such as laws and regulations. From the consumer perspective, it was observed that customers are concerned with environmental issues, and their purchase decisions about green-packaged products are dependent on different factors and variables, including their environmental concern regarding the packaging's design; the typology, biodegradability, and recyclability of packaging materials; and the origin of the products, among others.

A growing number of consumers are expecting companies to provide environmentally conscious packaging for brands and products with a view to protecting the environment, conserving resources and acting sustainably. And right at the top of their list of requirements is reduced plastic usage or substituting plastic for something else entirely. In addition to the selection of materials, other parameters are becoming important too, including the likes of production, supply chain, waste management, energy concept and reduced carbon footprint, to ensure the packaging produced really is *eco-friendly*.

Three principles make cardboard eco-friendly, sustainable packaging:

- *Renewable raw materials for folding boxes*. Cardboard is made of the renewable raw material wood, so it is one of the most sustainable packaging materials around. The process used to extract the raw material and the way cardboard is produced, used and disposed of promote eco-friendliness. Those who use FSC® and PEFC-certified materials are demonstrably supporting sustainable forestry and are ensuring that the carbon footprint in the fibre cycle is balanced. Renewable forests absorb the carbon released by cardboard, paperboard or paper packaging and promotional products at the end of their life cycles;

- *Reusing recycled materials.* Cardboard is sustainable, environmentally friendly and conserves our resources: Indeed, no other product is recycled quite as intensely as cardboard, paperboard or paper packaging. The fact that the raw material is reused several times over conserves resources in all areas, including energy and water consumption. The recycling rate for cardboard, paperboard and paper in Europe is around 81%.
- *Reduced material usage.* Smart packaging designs minimize material usage considerably. Sustainable packaging is characterized by the fact that it is made of eco-friendly materials and designed to be particularly sparing in its use of them. Consequently, there are fewer rejects in production and less waste after use (Three principles for eco-friendly, 2022).

For over a century the corrugated industry has built a business philosophy dedicated to responsibility, from worker safety to economic viability and environmental stewardship. (fig. 4).

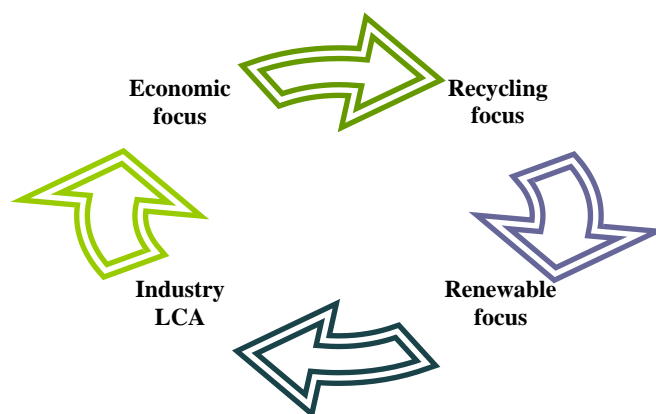


Figure 4. Sustainability of corrugated cardboard packaging

Source: <https://www.corrugated.org/responsibility/>, 2022

Economic focus. Corrugated packaging is cost-effective. Corrugated packaging is lightweight, lowering freight & handling costs with fewer trucks, less fuel and lower emissions. Corrugated is cost-effective and reliable, while attracting eco-conscious customers who prefer to choose sustainably packaged products. It’s the responsible choice that pays off.

Recycling focus. More corrugated packaging is recovered for recycling than any other packaging material. The recovery rate for old corrugated containers (OCC) has hovered around 90 percent for years. Recycling corrugated packaging decreases solid waste disposal. Collected fiber is then reused to make new corrugated packaging, allowing for the use of less new raw material. Recycling corrugated packaging also generates revenue for the end-user. Recovered material (called “OCC” or “old corrugated containers”) is a valuable resource to paper mills and manufacturers of new corrugated packaging.

Renewable Focus. Corrugated packaging is renewable. The journey of the corrugated box begins in a sustainably-managed forest. There, certified foresters and loggers harvest just enough trees to make packages. And for each tree harvested, three more are planted to take its place. Corrugated packaging is a completely renewable resource: environmentally responsible, recyclable and compostable. The corrugated packaging industry is committed to helping customers find responsible packaging solutions – to make products that are more sustainable. Corrugated is a very traditional form of packaging; it’s been around for 150 years, but it remains on trend today because of consumer desire for sustainable packaging. There’s a tremendous backlash against single-use packaging — particularly plastic — and that’s driven many in the supply chain to look more closely at corrugated because it’s made from a renewable resource, and has a very high recovery rate (92% in 2021). On average, corrugated boxes contain 52% recycled content which means corrugated boxes are made to be remade (Focus on Sustainability, 2022).

Corrugated Life Cycle Assessment. FEFCO (European Federation of Corrugated Board Manufacturers), together with CCB (Cepi Container Board), has released the new “European Database for Corrugated Board Life Cycle Studies 2021”. The 10th edition shows substantial developments and demonstrates the efforts made by the European corrugated industry and its paper suppliers to reduce their impact on the environment. One such aspect is the use of recycled material for the production of new corrugated packaging indicating an average of 88% recycled content in 2021. The report shows further improvements of environmental parameters:

- 18% reduction in consumption of wood and 4% reduction in the consumption of recovered paper, indicating continuous improvements to reduce resource use.
- 5% decrease in fossil fuel consumption.
- 28% decrease in emissions of NO_x at the production sites.
- 33% decrease in emissions of SO_x at the production sites (Birch, 2022).

Authors (Escursell et al, 2021) summarized that package distribution remains one of the main contributors to the environmental impact of packaging and is hence in need of more effective solutions. Further research is needed with a view to producing new packages from renewable sources such as cellulose-containing materials, which are widely available in nature, or from recycled cellulose based materials such as cartonboard. There is the need for effective ways of reducing costs and environmental impacts. Unlocking this situation will call for new design paradigms to be built, where cardboard packages can play an important role.

The sustainable status of cardboard packaging is also confirmed by consumer research. Consumer focus on sustainable packaging and sustainable shopping is accelerating – and brands across all industries should be prepared to address the demand. Data from Shorr’s *The 2022 Sustainable Packaging Consumer Report*, which looks at results from a survey of 1,113 U.S. consumers, highlights that 76% of the shoppers surveyed have made a conscious effort to purchase more sustainable products in the past year. In fact, 86% of the consumers surveyed are more likely to purchase a product from a brand or retailer if the packaging is considered sustainable. Additionally, 77% of the consumers surveyed expect more brands/retailers to offer 100% sustainable packaging for their products in the near future (The 2022 Sustainable Packaging, 2022). (fig. 5).



Figure 5. Consumer's factors about the environmental impact of packaging

Source: The 2022 Sustainable Packaging Consumer Report, 2022

Of the consumers surveyed, 63% are “extremely” or “very” concerned about the environmental impact of packaging. This was more than corroborated by the 89% of respondents who believe it’s “very” or “somewhat” important that the packaging of the products they purchase is recyclable.

Specifically, sustainable packaging plays a significant role in purchasing decisions – with 64% of respondents stating that sustainable packaging is a factor in their current product selection process. The most important factors for consumers around sustainability while shopping are addressed towards the brand and refer the material of packaging (fig. 6).

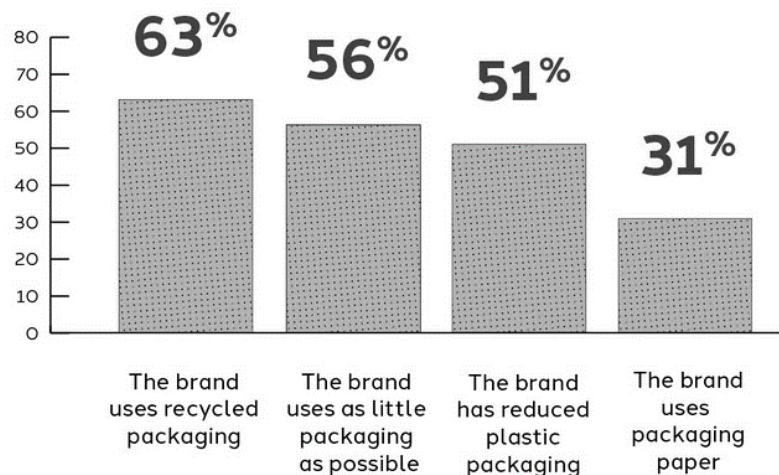


Figure 6. Consumer's factors about the sustainability of packaging

Source: The 2022 Sustainable Packaging Consumer Report, 2022

Given the data that the report highlights, there's no question that consumers are beginning to expect brands to evolve their packaging in ways that align with consumer sentiment around sustainability – with packaging playing a large role in customers' purchasing decisions.

The Circular Economy is business as usual for the Corrugated Packaging Industry. After all, today's corrugated packaging is perfectly circular: it's **100% recyclable, bio-based and biodegradable**. Circular by nature, corrugated packaging is bio-based and provides a natural alternative to fossil-based products. It's made almost entirely from natural materials: recycled and virgin fibres, along with natural starch-based glue. The fibres come from renewable sources, the sustainably managed forests, which is helping to preserve natural resources for current and future generations. Recycled paper provides 89% of the raw material for new corrugated boxes – ensuring the continuous life of the fibres while making a valuable contribution to our economy. All corrugated packaging has recyclability built in – it's a natural eco-design feature – and can be designed to fold easily, simplifying preparation for recycling. This allows corrugated packaging to continue to add value at the end of its use, with today's market for recovered paper providing value to every stakeholder across the supply chain. Lightweight, strong and versatile, corrugated packaging minimizes its impact on the environment throughout its entire life cycle – before, during and after use – confirming its perfectly circular model. It offers an infinite number of design possibilities. Its versatility means it can be adapted to precisely fit almost any shape and size, and designed to fold easily to save space. Life Cycle Analysis has been showing the sustainability of corrugated packaging as the most responsible packaging material for more than 30 years. Corrugated packaging's approach provides a great source of inspiration for other materials (FEFCO, 2022).

Conclusion

Sustainability is a defining category for all areas of business life today. Ensuring and maintaining sustainability is a guarantee of competitiveness. Sustainability *is an essential part* of production and business strategies in the pulp and paper industry, which is active in the three interdependent pillars of sustainability: environmental, economic and social. The pulp and paper

industry is representative of the *various aspects of sustainable development*. The combination of environmental, economic and social aspects of activities in the packaging sub-sector of the industry is an example of sustainability guaranteed within the framework of the circular and bio economy. Cardboard packages are *one of the most produced assortments in the paper industry*. They are an excellent example of production that meets the requirements of the circular economy, **based on the principles of sustainable consumption of resources, sustainable production and sustainable development**.

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